

## **INDUSTRY AND FOREIGN TRADE IN INDIA, CHINA, AND OECD COUNTRIES: AN ANALYSIS OF CAUSALITY, 1960-2002**

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### **Abstract**

We analyse causality relationships between industry, foreign trade and non industrial development in three major areas of the world economy: India, China and OECD countries for the period 1960-2002, and found that the effect of imports is usually positive and significant to favour industrial and non-industrial development in the domestic market. The positive effect of industry and foreign trade on non-industrial sectors is mainly contemporaneous and the tests based on VAR models can be affected by the omission of relevant current variables, and unduly lead to acceptance of non-causality.

JEL classification: C5, F1, O5, O51,O52,O53,O57

Key words: Foreign Trade, Causality, India, China, OECD

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### **1. Introduction**

As Klein(2004) has pointed out the challenges of economic development in China and India are formidable, not only for their domestic markets but also because they are an example for other developing countries and have an important impact on international markets. The increase in the degree of development and openness in both giant countries is outstanding and it has important effects on industrialized and non industrialized countries. Here we analyse causality between Industry and Foreign Trade in India, China and OECD countries, as well as among these variables and non-industrial growth. Section 2 analyse the evolution of the main variables and presents a short summary of the economic literature related with the role of foreign trade on domestic supply. Section 3 analyses the impact of imports on industrial and non-industrial value-added by means of a mixed dynamic model, and shows the positive effect that imports has on economic development on the current period. Section 4 analyses presents the results of trivariate Granger's causality and shows that the omission of relevant current variables in the VAR's approach can lead to misguided conclusions, regarding the role of

foreign trade, being generally preferable to use mixed dynamic model and other approach for this purpose. Finally section 5 presents the conclusions.

## **2. Industry and Foreign Trade in India, China and OECD**

The positive effects of industry on the supply of services are usually twofold: directly, by increasing the availability of intermediate and capital inputs from domestic origin, and indirectly, increasing exports and, as a consequence, the capacity to import intermediate inputs and other factors of production.

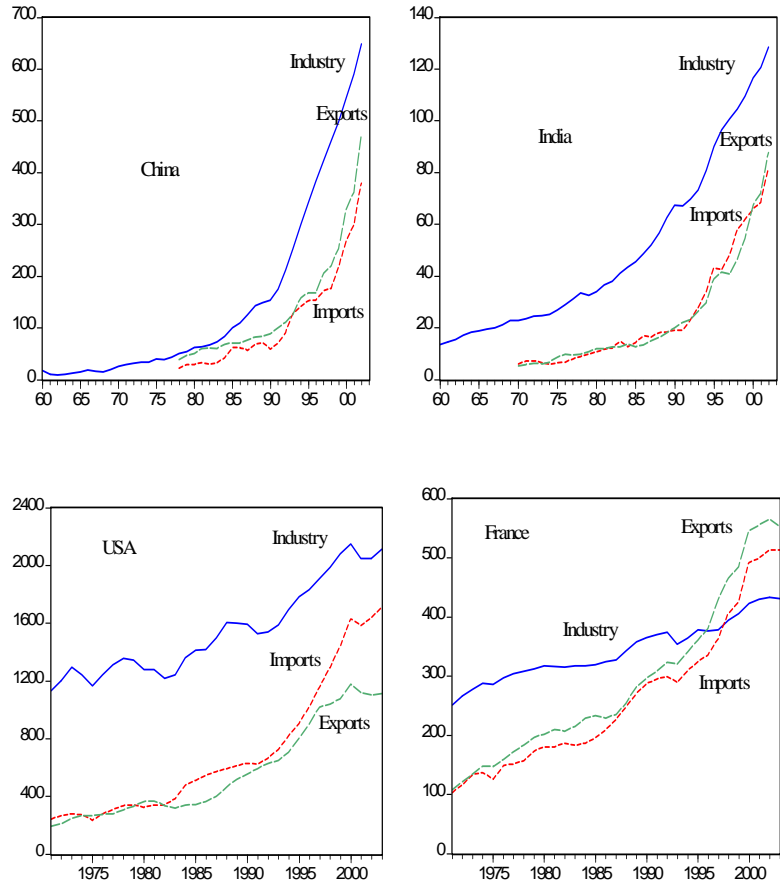
Some interesting contributions to the analysis of the supply side in India, China and OECD countries are, among others, the following ones: Klein(1989) analysing the effects of demand and supply on macroeconomics, Klein and Ichimura(2000) who present an interesting analysis of econometric models of growth in China, particularly from the point of view of demand and supply of primary inputs, through production functions.

In the case of India, Pandit(2002) also recommend the analysis of supply side, and considers that for developing economics it is more important to have into account restrictions from supply side and focus more on long term relationships than on short-term fluctuations.

Dees(1999) analyse the role of external variables in China, Liang(2000) comments on the important role of intermediate goods for economic growth in China and points that both supply and demand have shown some limitations, although restrictions from supply side have been general stronger. Karras(2003) present an international analysis of causality between growth and foreign trade, having into account the important effects of exports on the demand side. Regarding the positive role of imports from the supply side some interesting articles are, among others, Guisan(1980) and (2005a) for OECD countries, Guisan(2004) for India, China and Japan, and Guisan(2005b) estimating a cross-section model of 112 countries.

Graph 1 shows the positive evolution of real value-added of industry and foreign trade for the period 1960-2003, in billion dollars at 1995 prices and exchange rates, in China, India, the USA and in France, being this country representative of the evolution of several European countries.

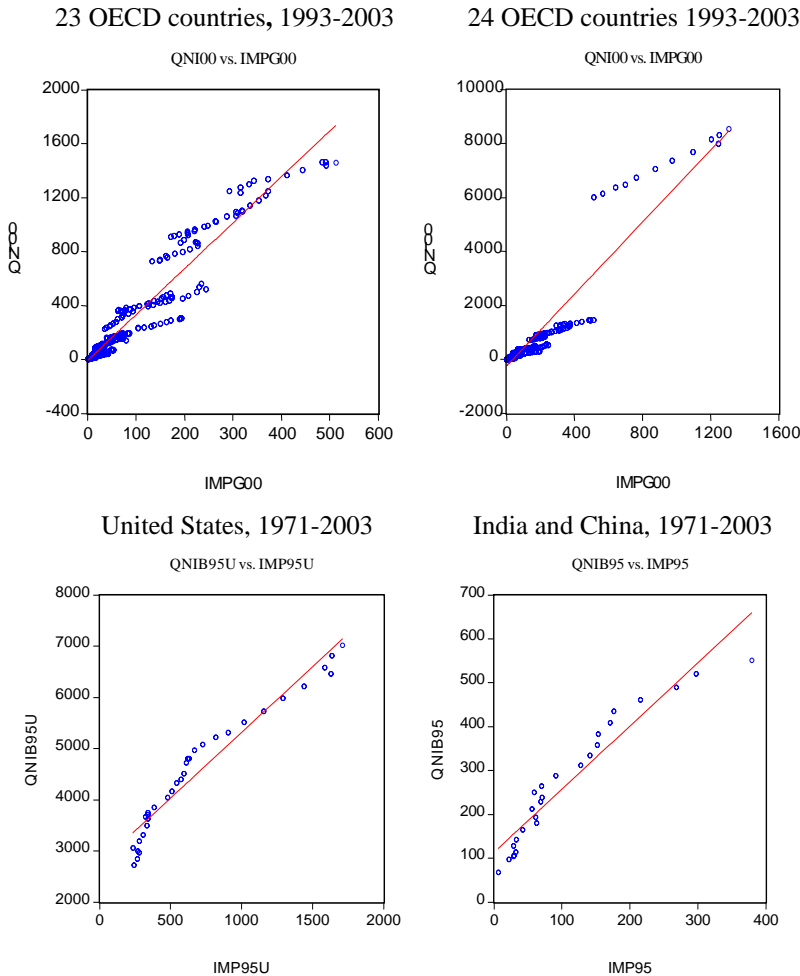
Graph 1. Real value-added of Industry and Foreign Trade  
(Billion of dollars at 1995 prices and exchange rates)



Source: elaborated from WB(2005) and OECD(2005)

Graph 2 shows the positive relationship between imports and non-industrial sectors in China, India, the USA and 24 OECD countries.

Graph 2. Non-industrial real value-added and Imports (Billion \$)



Notes: qni is non industrial value-added elaborated from OECD statistics; qnib is non industrial value-added from WB statistics; impg is imports of goods, and imp is imports of goods and services. Real values.

The group of 23 OECD countries includes: Austria, Australia, Canada, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Luxembourg, Mexico, Netherlands, New-Zealand, Poland, Slovakia, Spain, Sweden, Switzerland, and the UK, and the graph for 24 countries also includes the USA. The figures 95 and 00 indicates, in the names of variables, correspond, respectively, at 1995 and 2000 prices and exchanges rates.

We can notice that the intercept may differ among OECD countries but the slope of the linear relationship is rather homogeneous in different countries. In the next sections we analyse contemporaneous and non contemporaneous causality between these variables.

### 3. Analysis of contemporaneous causality

Imports of goods complementary to domestic production can lead to an increase in real value-added of industry and/or non-industrial sectors during the current year, and thus we should consider a contemporaneous relationship. Before to analyse the possibility of a interdependence we present in tables 1 to 3 the estimation of the following mixed dynamic model:

$$y = f(y(-1), D(x), d(\text{imp})) \quad (1)$$

In the case of table 1 data are in billion dollars at 1995 prices and exchange rates, being  $y=q_i$  (industrial value-added) or  $q_{ni}$  (non-industrial value-added),  $x=q_{ni}$  or  $q_i$ , and  $\text{imp}=\text{imports}$ .

Table 1 shows a positive and significant effect of imports both on industrial and non-industrial sectors in all countries with the only exception of non-industrial sectors in China, where the hypothesis of null effect is accepted with this sample. Regarding the interrelationships between  $q_i$  and  $q_{ni}$  the estimated coefficients are positive, as expected, but not significant with the only exception of the effect of  $q_i$  on  $q_{ni}$  in the case of China. The lack of significance

may be mainly due to problems of multicollinearity, the inclusion of building in industrial data and/or to the effect of missing explanatory variables.

Table 1. Model (1) in China (cn), India (in) and the US(u):1970-02

Y	Y(-1)	D(X)	D(IMP)	Adj.R <sup>2</sup>	Method	ADF	Prob
qicn	1.0420*	0.6503*	0.1863*	0.9985	GLS	-2.49	0.01
qiin	1.0548*	-0.0353	0.2224**	0.9975	GLS	-4.80	0.00
qiu	0.9807*	0.1237	0.8173*	0.9832	GLS	-4.51	0.00
qnicn	1.0438*	0.2604	-0.0585	0.9991	GLS	-3.12	0.00
qniin	1.0621*	0.1815	0.5264*	0.9991	LS	-2.28	0.02
qniu	1.0027*	0.2881	0.4915**	0.9983	LS	-4.26	0.00

Note: \*, \*\* significant at 5% and 10% level. Method: LS or GLS with AR(1). ADF tests support co-integration, prob is the significance level of one sided-test for ADF. Data source WB(2005): Industry includes Manufacturing, Energy and Building. All the signs are correct but the negative signs of coefficient of D(X) for Y=qiin (-0.0353) and the coefficient of D(IMP) for Y=qniin. The wrong negative signs may be due to the high degree of multicollinearity in samples of individual countries and usually disappear in pooled samples of several countries, or to other causes analyzed in this study.

To improve the results we present in the following tables and analysis of manufacturing and non-manufacturing sectors. In tables 2 and 3, data are in constant dollars per inhabitant, being y=vmh or vnmh (real value-added of manufacturing and non-manufacturing) and imph=imports per capita. Data sources are OECD, World Bank and SYCN.

Table 2. Model (1) for vmh, in China, India, and OECD countries

Country	Method	Period	vmh(-1)	D(vnmh)	D(imph)	Adj.R <sup>2</sup>
China	GLS	80-02	1.0599*	0.0824	0.1652*	0.9987
India	LS	71-02	1.0251*	0.0243	0.1201*	0.9879
OECD16	LS-W	60-97	0.9988*	0.1154*	0.2304*	0.9923

Note: Data for China and India in dollars at 1995 PPPs, and for OECD in dollars at 1990 exchange rates. LS-W: Least Squares-White consistent, GLS Generalized LS with AR(1). \* Significant at 5% level. Signs are correct.

Table 3. Model (1) for vnmh in China, India, and OECD countries

Country	Method	Period	vnmh(-1)	D(vmh)	D(imph)	Adj.R <sup>2</sup>
China	GLS	80-02	0.9898	1.6765**	0.0014	0.9934
India	LS	71-02	1.0408	0.1218	0.7248*	0.9982
OECD16	LS-W	60-97	1.0088*	0.4044*	0.4522*	0.9980

Note: Data for China and India in dollars at 1995 PPPs, and for OECD at 1995 exchange rates. LS-W: Least Squares-White consistent, GLS Generalized LS with AR(1). Significance: \* at 5% and \*\* at 10% level.

Non manufacturing in China has been calculated as total Value-added from SYCN less Manufacturing Value-Added from WB. The OECD sample includes the following 16 countries: Austria, Belgium, Canada, Denmark, Spain, France, Finland, Greece, Netherlands, Italy, Japan, Mexico, Portugal, Sweden, United Kingdom and United States.

In tables 2 and 3 Imports shows a significant and positive impact in all the cases but the case of the equation of vnmh in China, where the estimated effect is almost null. This may happen because China's imports are more addressed to the needs of domestic manufacturing and less to the development of other sectors, or to a downwards biased due to a possible underestimation of the Value-Added of Services, as stated in Guisan and Exposito(2004).

On the other hand, manufacturing seems to have a strong, positive and contemporaneous effect on non manufacturing, while the reverse relation could be lagged and/or more moderate. In other studies we have found similar results for Latin American and other areas, and the model presented in Guisan(2005b) shows the positive impact of industry and imports, among other variables, on the real value-added of services with an international cross-section of 112 countries in the year 1999.

#### **4. The effects of missing variables on Granger's causality test.**

VAR models do not have into account the current relations between variables at time t, because they only include as explanatory variables lagged values, and some times other explanatory variables

are missing although their effects may be partly transmitted to the model if they are linearly correlated with the regressors of the VAR model. Thus the effects of missing explanatory variables may affect the estimation and significance of parameters in those models, particularly those due to the values of relevant contemporaneous variables, which may affect to the sign and significance of the coefficients of the Granger's causality test.

Tables 4 presents the equation of Y2, with a trivariate VAR model with one lag, estimated with the same data of section 3. All the variables are at constant prices.

Y1=Industrial Value-Added (qib in some cases, qmh in other ones)

Y2=Non-Industrial Value-Added (qnib or qnmh)

Y3=Imports (in totals or per inhabitant)

We can notice that VAR models fail to show the positive and significant impact of Y1 and Y3 on Y2 when it is relevant, mainly due to the effect of the missing value of current values of the explanatory variables, as VAR models only included lagged values.

Table 4. Trivariate Granger's test: Effects of Y1 (Industry) and Y3(Imports) on Y2(Non-Industrial sectors)

Y2	Country	Sample	Y2(-1)	Y1(-1)	Y3(-1)	Adj.R2
qnib	China	79-02	1.0972*	-0.0349	0.0060	0.9990
qnib	India	71-02	0.8202*	0.5595*	0.6096*	0.9992
qnib	USA	72-03	0.9819*	0.1112	0.0657	0.9974
qnmh	China	80-02	0.8832*	0.5596	-0.4208	0.9923
qnmh	India	71-02	0.8538*	0.8092*	0.4798*	0.9986
qnmh	OCDE16	77-95	0.6372*	0.5633*	0.1185*	0.9979

Note: Data from WB, OECD and China Statistics SYCN. Estimation method: LS in India, GLS with AR(1) in China, pooled LS-W in OECD countries. The first three rows use qnib as non industrial and qib as industrial (real value added of industry and building) and the last three rows use qnmh as non industrial and qmh as industrial (real value added of manufacturing per inhabitant). Notice that the lack of significance of some coefficient and the wrong negative sign of the coefficient of Y3(-1) in China may be due to the effect of missing relevant variables as above explained.



Bivariate Granger's tests, with one or more lags, presented similar problems: Although some causal relationships were accepted, their results were far from showing the general significant and positive effect of imports and industry on non-industrial sectors, mainly due to the omission of contemporaneous relationships.

Regarding the role of exports we have found that sometimes show a positive impact from the demand side, but generally its main positive impact on economic development comes from the supply side, due to the fact that they are usually the main source to finance an increase of imports of complementary goods and services which are intermediate factors of production which increase real Gross Domestic Product. For a more detailed analysis of econometric models related with the positive effects of imports and exports on economic development see Guisan(2006).

## **5. Conclusions**

We agree with Waeld and Wood(2004), who state that *"the existing literature repeatedly documented a strong correlation between trade and growth. It has also shown a causal effect of imports (though not necessarily exports) on growth in simultaneous equation models but to a lesser extent in Granger-causality tests."* Thus we insist upon the importance to have into account the effects of foreign trade on economic development from the supply and the demand side.

Our results support the important and positive role of imports to foster domestic growth from the supply side. The role of foreign trade is usually more important from the supply side (increase of imports of goods and services which contribute to increase domestic production) than from the demand side (increase of foreign demand of exports). Generally speaking Exports are important mainly because they contribute to increase Imports of goods and services necessary to foster domestic production and real Income, and besides Exports may accelerate industrial and non industrial production from the demand side with a positive effect on real Gross Domestic Product.

Regarding the econometric methodology, it is important to have into account the positive effect of contemporaneous imports on domestic production. Granger's test and VAR models are interesting but their results may be seriously affected by the exclusion of current variables, while the mixed dynamic model shows more interesting results in this regard. It is important to have these considerations into account and to interpret the results in a flexible and non rigid way when performing those tests.

Regarding economic development in China and India, accordingly with Klein(2004) we must be aware of the important effects that this will have on world development, not only by the remarking effects of their own industrial development and trade, but also because they will be examples to follow by many developing countries in order to achieve higher degrees of economic development. It is expected a higher increase of industrial production and foreign trade of both countries.

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